Abstract No. ran340

Strain-induced Crystallization from Glassy State of PET Film by In Situ WAXD

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Beamline(s): X3A2

Introduction: Poly(ethylene terephthalate) (PET) is the most commercially important polyester. Strain-induced crystallization is one of the most interesting issues, which attracted lots of scientists. Porter *et al* pointed out that the lattice of stress-induced crystallites was far from the closest packing[1]. Bonart was the first to report the occurrence of a paracrystalline structure in the PET. He observed that the structure of PET developed during the drawing from a totally amorphous to a nematic and finally to a smectic state. An observation of the formation of a transient smectic phase was reported recently by several groups during the annealing of cold-drawn PET film[2-3].

Methods and Materials: In this work, a modified Instron 4410 has been adapted to the three-pinhole SAXS/WAXD facility at X3A2/NSLS/BNL to perform online WAXD determinations of strain-induced crystallization of PET. A totally amorphous PET film was first stretched to extension of 100% at 50 ºC at a stretch rate of 10 mm/min. Then the sample was heated to different temperatures under constant strain. The images were taken every 20 seconds by Mar CCD detector.

Results: The results showed that the amorphous phase oriented when PET was stretched. It is very interesting to note that besides the amorphous peak, one more peak appeared on meridian (corresponding to d spacing of 9.4 Å) very soon (at extension of ~50%). This peak developed during the stretching. This result indicated that the mesophase was formed in the PET film while stretching below T_g. There was no obvious sign of crystalline below T_g. The crystalline started to form when the temperature was higher than T_g and the mesophase peak became smaller and finally disappeared. More detailed analysis of the X-ray diffraction data is underway.

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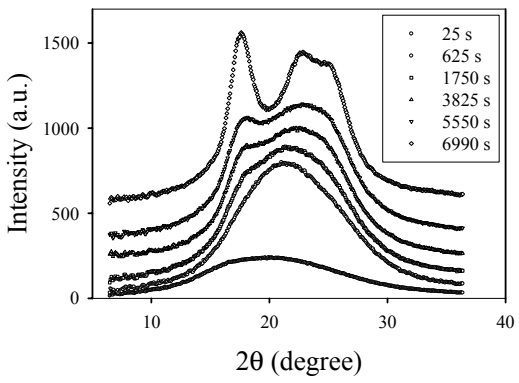

Figure 1: Equatorial intensity (azimuthal average)

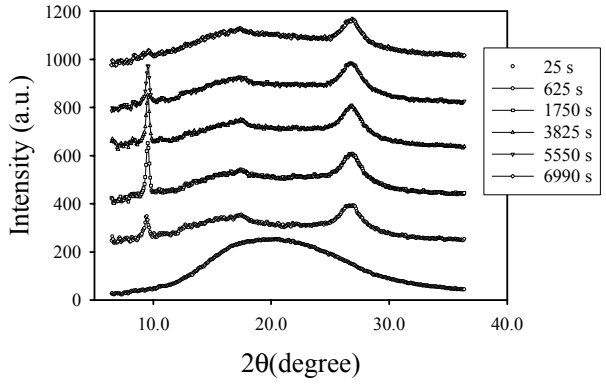

Figure 2: Meridional intensity of PET film of PET film at different stages.